Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

PUBLICATIONS OF THE LICK OBSERVATORY, VOLUME XI: PHOTOGRAPHS OF THE MILKY WAY AND OF COMETS; BY E. E. BARNARD: A REVIEW.

By Joel H. Metcalf.

No publication of the Lick Observatory since Volume VIII, which contained reproductions of the photographs taken by Professor James Edward Keeler with the Crossley reflector has such general interest as Volume XI, which has just issued from the press. It contains reproductions of photographs of the Milky Way and of comets made with the 6-inch Willard lens and Crocker telescope during the years 1892 to 1895 by Professor E. E. Barnard at that time Astronomer in the Lick Observatory.

As the Crossley telescope is 36 inches in aperture, one might think that the next photographs reproduced would be those taken with some larger instrument, say of 60 or 100 inches aperture; but, instead, these photographs, which were the first of the kind and most wonderful in their results, were made with an instrument nominally only six inches in aperture and really smaller. Professor Barnard has been a daring and a most successful astronomical discoverer, but never did he show such radicalism as when he, one of the keenest sighted and most experienced of observers, spent night after night in photographing the sky with so small an instrument and one that was not even made for the stars. It was originally a portrait lens, of the form adapted to the old "wet-plate" process of photography, and long ago discarded by photographers as a result of the invention of the "dry-plate" and the anastigmatic lens. The volume under review is a proof that the old scriptural saying may have a modern application, for in it the lens that the builders rejected is head of the corner.

How the lens came to be used in astronomical work on Mount Hamilton is described by Professor Barnard in the introduction. The first experiments in astronomical work with an old-

fashioned portrait lens of the Petzval type were made by Dr. DAVID GILL at the Cape of Good Hope on the great comet of 1882. In January, 1889, a 6-inch "Willard" lens was used by WM. IRELAND to photograph the total eclipse of the Sun, and its success then led to its purchase by Director HOLDEN for the Lick Observatory, the funds being provided by the Hon. C. F. CROCKER, Regent of the University of California. The information given shows that the lens was neither made by WILLARD nor is it six inches in aperture. WILLARD & Co., who have their name upon it were stock dealers only. The lens was made by CHARLES F. USNER in New York City. His name should not be forgotten, for it is doubtful if lens-makers of to-day can turn out an instrument greatly its superior.

It is true, however, that BRASHEAR has refigured it, which doubtless adds much to the sharpness of its images. The chief limitation of the original lens must have been the fact that the optical and visual foci coincided, as was necessary for focusing in the old wet-plate process. A modern instrument made exclusively for astronomical photography would have a better color correction and would give sharper images; otherwise it could not be greatly improved upon to-day. It is rather disconcerting that so little progress in the construction of astronomical lenses of large relative aperture has been made in the last fifty years. The only improvement, in the opinion of the writer, is the 10-inch Franklin-Adams lens made by TAYLOR of COOKE & Co., York, England, and it is practically impossible to get discs of the proper kind of glass for apertures larger than this.

Returning to the Willard lens, it is interesting to know that the clear diameter of the front lens is only 5.85 inches and that this is still farther cut down by a diaphram less than four inches in diameter, placed between the front lens and the back lens of the combination. But lenses, like wisdom, are justified of their children and Professor BARNARD has shown what this lens can do in skillful hands.

In the volume are 128 collotype plates, 89 of them of regions of the sky mostly along the Milky Way and the rest of comets. Professor BARNARD's decision to use the collotype process seems especially fortunate. The reproduction of star pictures

to retain the fainter stars without loss of the fainter detail in the nebulæ is an art in itself, as difficult perhaps as making the original photographs. Mr. A. B. BRUNK of the Chicago Photogravure Company has succeeded admirably and must have put much patience and many labors of love into this work. Not all the reproductions are equally good, but when Professor BARNARD says, as he does often, "this is an excellent reproduction," there must have been very little in the original that does not show in the copy.

Professor BARNARD has given some very important technical hints in regard to the production of astronomical photographs in his Introduction. One might wish he had gone farther and told us about his enlargements of the original negatives—why he did not use contact reproductions and what was done to increase contrast in the tails of comets and the dark places and lanes in the Milky Way. In some of the pictures which have been several times enlarged the background shows a mottled appearance, doubtless due to the grain of the plate, but which some might take for a background of very faint stars.

Just a few words in regard to the plates themselves. The large number is food for thought for those who live in the cloudy atmosphere of the effete East. What a wonderful climate has Mount Hamilton to make it possible to get such a large number of long exposure plates in three or four years! For one who has ever tried to take a long-exposure plate there is a deep appreciation of the long and wearisome hours spent by Professor BARNARD, sitting with his eyes "glued" to the following telescope. Without counting the comet pictures and making no allowances for failures, which are very common with most observers, a rough estimate shows that he spent 286 hours with the shutter open taking the Milky Way pictures alone, and in the list many continuous runs of five hours, six hours, and even seven hours are found, and one of them (the picture that shows the nebulosities around the *Pleiades*) is of ten hours and fifteen minutes' exposure.

The results of these indefatigable labors are a wonderful addition to our knowledge of the Milky Way and of comets. The human eye directly, no matter how great the power of

the telescope, could never have seen the structure of the Galaxy or of comets' tails. The cumulative effect of light on a photographic plate and the fact that it does not require a magnification of four or five to each inch of aperture, as does the human eye, makes these wonderful pictures possible.

There is one thing about these pictures, however, that it is well enuf to bear in mind. The relation between the brightness of the stars and the brilliance of the nebulosities is a purely artificial one. It would be possible to photograph every one of the stars upon these plates without showing a particle of nebulosity. It would also be possible to photograph the nebulosities and show scarcely any stars. A short-focus lens of great relative aperture "sees" the nebulosity rather than the stars and a long-focus lens of small aperture and great defining power would take the stars and not the nebulosity.

I must not say anything about the pictures in detail. They speak for themselves, and added to that, Professor BARNARD has for many of them pointed out features and made judgments which to the reviewer seem on the whole most just and conservative. Undoubtedly, however, there will be considerable difference of opinion as to how certain features should be explained. Some of the forms shown in the Milky Way must be due to chance, just as the "crouching beast" (Plate 45) is, and it would be folly to try to explain forms that have only accident for their cause. That remarkable line of stars on Plate 39 may be an example. If a person should splash ink in small spots on a wall, he would doubtless discover some interesting forms, but they would be as imaginary as the Castles or the Camels of the Clouds. There are other pictures, however, in which the streaming of stars in lines and net-work seems most real.

The interpretation of the vacancies and the lanes is interesting. Professor BARNARD thinks that in certain cases the absence of stars is due to an absorbing medium simply covering up the stars, and that the large telescopes to which he has had access show some of these to be slightly luminous. One could wish that he had correlated these observations with some of his more recent photographs of dark lanes, where, if the writer's memory serves, he took the point of view that the lanes were darker

than the general background of the sky on his plates. It is possible that this difference might be reconciled,—perhaps by the difference in the instruments. Could an object be darker than the surrounding sky to a Petzval doublet and brighter to the human eye in a 40-inch refractor?

Professor BARNARD'S comet pictures are most interesting. Brooks' Comet of 1893 must have been much like and perhaps more remarkable than the famous Morehouse Comet. It is a pity that other astronomers did not get a series of photographs of it, for it evidently would have given opportunity, even better than Morehouse's Comet, for measurements of regression of luminous matter in the tail.

Professor BARNARD'S ingenious and successful combinations of photographs taken on different nights to show the freak motions and changes in the tail are also most interesting. That these changes cannot all be explained by eruptive disturbances and by varying speeds of repulsion of luminous particles from the head, without the necessity of assuming some kind of streaming in space, does not seem to me proved.

The volume as a whole is a notable contribution to astronomy. It is a great credit to the Lick Observatory, to the people whose generous contributions made its publication possible, to the Willard lens, and, most of all, to Professor BARNARD.

WINCHESTER, MASS., November 4, 1914.

NOTE ON A 570.

BY ÉRIC DOOLITTLE.

The recent announcement by Dr. AITKEN, in *A. S. P.*, XXVI, page 205, in regard to the interesting and rapid binary A 570, was of special interest to me because for some years I have been keeping watch of this important pair. I find that I have secured measures of it on twelve nights altogether, and while in view of Dr. AITKEN'S most accurate measures these must lose much of their value, yet as two of the series of measures were secured during years when the pair was not measured